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Effect of various organic manures on growth and yield of okra [*Abelmoschus esculentus* (L.) Moench]

Ruchika Abha, ML Meena, Rajmani Singh and Rupesh Kumar Mandal

Abstract
The field experiment was conducted at Horticultural Research Farm Babasaheb Bhimrao Ambedkar University, Lucknow (U.P.) during Rabi season of 2018-19 to study the eeffect of various organic manures on growth and yield of okra [*Abelmoschus esculentus* (L.) Moench]. Results revealed that plant height, number of leaves, stem diameter, number of branches per plant, days took to first flowering, days took to 50% flowering, number of fruit per plant, fruit yield per plant (g), fruit length, fruit weight and fruit yield were maximum with the application of the 2.5 ton Vermicompost + 2.5 ton Poultry manure ha^{-1} and followed by 10 ton + 2.5 ton ha^{-1} Poultry manure in okra.

Keywords: Manures, okra, vermicompost, Neem cake, FYM and yield

Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] belongs to the family Malvaceae and one of the prominent vegetable crops in the world. It is highly nutritious vegetable crop. India is the largest producer of okra in the world. The major okra growing states are Uttar Pradesh, Odisha, Bihar, Andhra Pradesh and West Bengal. Tender pods used for vegetable, canned as well as dehydrated form. Generally edible tender fruit of okra are used as a culinary and sliced purpose. The stem of okra is used in clarification of sugarcane juice and during jaggery preparation. It requires warm and humid conditions for good growth. It is susceptible to low temperature. It is adapted to a wide range of soils from sandy loam to clayey loam having pH range 6.5- 7.7. It can be planted in both summer and rainy season crop. Being a short duration crop, its growth and yield characters are largely affected by judicious use of nutrient management practice. Sole application of chemical fertilizers to meet the crop nutrient demand is deleterious for both soil and environment (Thirunavukkrasu and Balaji, 2015) [13]. Poultry manure has a fairly high nutrient composition when compared with other source of animal manure. Use of organic manures aims to meet the nutrient availability of crop would be an inevitable practice in the coming years to come for sustainable agriculture practices. Organic manures encourages the soil physical, chemical and biological properties along with conserving and improve the moisture holding capacity of soil and results into enhanced crop productivity along with maintaining the quality of crop produce Poultry manure, Neem Cake and cow dung manure are very good sources of organic matters and play a vital role in soil fertility improvement as well as supplying primary, secondary and micronutrients for crop production. Use of Vermicompost can increase fertility of soil physically, chemically and biologically. Physically, Vermicompost treated soil has perform better in terms of aeration, porosity, bulk density and water retention capacity. The chemical properties such as pH, electrical conductivity and organic matter content are also improved for better crop yield.

Materials and Methods
A field experiment was carried out during summer season 2018 at the Horticultural Research Farm, Babasaheb Bhimrao Ambedkar University, Lucknow. Lucknow is located at 25º15' North latitude and 83º03' East longitude at an elevation of 123 meter above mean sea level on the bank of river the Gomati. The experiment was laid out in Randomized Block Design with three replication and 10 treatments. Treatment combinations were, T_0-Control, T_1-FYM @ 20 t/ha, T_2-Vermicompost @ 5t/ha, T_3-Poultry manure @ 5t/ha, T_4- Neem Cake @ 2 t/ha, T_5-FYM @ 10 t/ha + Vermicompost @ 2.5 t/ha, T_6-FYM @ 10 t/ha + Neem Cake @ 2.5 t/ha, T_7-FYM @10 t/ha + Poultry manure @ 2.5 t/ha, T_8-Vermicompost @ 2.5t/ha+ Neem cake @ 1 t/ha, T_9-Vermicompost @ 2.5 t/ha + Poultry manure @ 2.5 t/ha, T_{10}-Neem cake @ 1t/ha+ Poultry manure @ 2.5 t/ha. The seed are sown direct in the field.

Light irrigation is given just after sowing the seed. Seed of cultivar spacing with a row to row 30 cm and plant to plant 30 cm having plot size 1.8 × 1.2 m. The observations to be recorded plant height, number of leaves, stem diameter, number of branches per plant, days took to first flowering, days took to 50% flowering, number of fruit per plant, fruit yield per plant (gm), fruit length, fruit weight, fruit yield per plot (kg) and fruit yield per hectare per (q). All the data obtained with regard to the growth, yield and quality attributing were analyzed statistically using the analysis of variance of Fisher (1958) [2].

Results and Discussion

The data (Table 1) showed that variations in different growth parameters were observed under different organic manures. Over all the application of Vermicompost along with poultry manure has favourable effect on plant growth. It is evident that maximum plant height (80.25 cm) was observed with Vermicompost 2.5 t/ha + PM.5 t/ha, followed by 10 t FYM/ha + 2.5 t PM $ha^{-1.}$ It might be due to moisture and nutrient absorption from the soil. It is due to the effect of the increase in concentration of auxin supply with higher levels of nitrogen brought about increase in the plant height and also due to nitrogen availability during early period of plant growth which leading to conductive nutritional environment in root zone of soil and promotes physiological activity. Nitrogen plays a key role in plant growth and development. Increase supplies of available phosphorus are playing an important role in metabolic reaction, energy conservations and biological energy transformations. Formation of storage compounds (ATP and ADP) leads to increased activity in cell growth and provide energy to the cells. Similar finding were also reported by (Sachan *et al*., 2017) [10], (Meena *et al*. 2019) [6] in okra. Stem diameter found to be maximum found in application of Vermicompost 2.5 t/ha + PM.5 t/ha, followed by 10 t FYM + 2.5 t PM ha^{-1}. The findings collaborated with (Amairy *et al*., 2018), (Meena *et al*. 2019) [6] in brinjal. The maximum number of leaves per plant (38.33) was recorded significantly higher in treatment 2.5 t Vermicompost + 2.5 t PM ha^{-1} and followed by treatment of T_7, the number of leaves per plant increased might be due to the okra with treatment Vermicompost along with poultry manure which enhances development of root and increase uptake of nutrients (Kishan *et al*., 2001) in cowpea and (Mishra *et al*., 2017) [7].

Significantly, days to first flowering were recorded (37.33 days) in the treatment of 2.5 t Vermicompost + 2.5 t PM ha-1 and days to 50% flowering were recorded minimum (41.33 days) with treatment 2.5 t Vermicompost + 2.5 t PM ha-1 and followed by the treatment of T_7. Application of Vermicompost along with poultry manure of the recommended doses of organic fertilizers induced early flowering and first flowering. Increased production of leaves might have helped to encouraged more photosynthetic and induced flowering stimulus, thus effecting early initiation of flower bud. It might be due to formation indole acetic acid and enhanced nitrogenise activity and leads to early flowering. Higher amount of nitrogen results to delay flowering. The application of higher dose of nitrogen ultimately leads to luxurious growth during vegetative phase ultimately delayed flowering. This is in close conformity with the findings of Jose (1988) [3] and Nandhakumar (1997) [8] in brinjal. Maximum number of branches per plant (4.67) was recorded with treatment of 2.5 t VC + 2.5 t PM ha^{-1}. The increased branches as a result of the combined application is due to higher absorption of nutrients especially nitrogen which might have enhanced the cell division and cell elongation and concomitant increase in metabolic activity. It could be due to the sufficient supply of all the major nutrients which are essential for growth and development of plant parts. Nitrogen being constituent of protoplasm and its favourable effect on chlorophyll content of leaves might have resulted in encouraged synthesis of carbohydrates (Tisdale *et al*., 1985).

Yield and yields attributed traits

The data recorded on yield and yield attributing trades presented in table 2 revealed significant variations among the various organic manure. The maximum fruit length (7.12 cm), fruit weight (11.53 g) and number of fruits per plant (8.33) were recorded with treatment 2.5 t VC + 2.5 t PM ha^{-1} and followed by the treatment of T_7 respectively. The yield of okra crop per plant found be maximum at application of 2.5 t VC + 2.5 t PM ha^{-1} (139.03 g). It involved in the various functions of endogenous hormonal regulation in the plant tissues and responsible for promoting pollen germination and pollen tube growth and ultimately leads to fruit length and weight. The higher fruit weight in these treatments might be due to accelerated mobility of photosynthetic from the source to the sink as influenced by the growth hormone, released or synthesized due to the organic sources of fertilizers (Susan, 1995) [12]. The findings of this study are in accordance with those of Mal *et al*. (2014) [11] in okra.

Table 1: Effect of various organic manures on growth parameters of okra.

Treatment	Plant height	Branches/ plant	Leaves/ plant	Stem diameter (mm)	Days to first flowering	Days to 50% flowering
T_0 Control	71.6	2.6	24.6	14.6	47.6	50.0
T_1 20 t FYM ha^{-1}	74.2	3.3	31.3	17.5	46.6	47.6
T_2 5 t/ha VC ha^{-1}	74.8	3.3	32.6	18.5	47.0	46.6
T_3 5 t/ha PM ha^{-1}	75.1	4.0	33.6	21.1	45.3	46.3
T_4 2 t/ha Neem Cake ha^{-1}	74.2	3.3	29.3	16.4	47.3	48.3
T_5 10 t/ha FYM + 2.5 t/ha VC ha^{-1}	78.2	4.0	36.6	23.4	39.3	43.6
T_6 10 t FYM + 2.5 t Neem Cake ha^{-1}	76.7	3.3	34.6	22.4	43.3	45.6
T_7 10 t FYM + 2.5 t PM ha^{-1}	79.7	4.3	37.6	24.5	38.3	42.6
T_8 2.5 t VC + 1 t Neem Cake ha^{-1}	76.9	3.3	35.6	22.5	41.3	45.0
T_9 2.5 t VC + 2.5 t PM ha^{-1}	80.2	4.6	38.3	25.5	37.3	41.3
T_{10} 1 t Neem Cake + 2.5t PM	77.7	3.6	36.3	23.2	40.3	44.3
S. Em (±)	0.92	0.62	0.99	0.67	0.83	0.65
C.D. 5% (P =0.05)	1.94	20.82	2.97	1.99	2.47	1.92

Table 2: Effect of various organic manure on yield and yield attributing traits of okra.

Treatment	Number of fruits per plant	Fruit Length	Fruit Weight (g)	Fruit yield/ plant(g)	Fruit yield/ha (q ha^{-1})
T_0 Control	3.3	2.9	8.3	120.3	1.9
T_1 20 t FYM ha^{-1}	4.6	4.5	9.0	126.3	2.0
T_2 5 t/ha VC ha^{-1}	5.0	4.6	9.0	127.6	2.0
T_3 5 t/ha PM ha^{-1}	5.3	4.7	9.2	129.8	2.0
T_4 2 t/ha Neem Cake ha^{-1}	4.3	3.0	9.10	123.6	1.9
T_5 10 t/ha FYM + 2.5 t/ha VC ha^{-1}	7.6	6.0	10.40	136.4	2.1
T_6 10 t FYM + 2.5 t Neem Cake ha^{-1}	5.6	5.0	9.30	132.0	2.1
T_7 10 t FYM + 2.5 t PM ha^{-1}	7.6	6.1	10.80	139.8	2.2
T_8 2.5 t VC + 1 t Neem Cake ha^{-1}	6.3	5.3	9.40	135.0	2.1
T_9 2.5 t VC + 2.5 t PM ha^{-1}	8.3	7.1	11.20	139.2	2.3
T_{10} 1t Neem Cake + 2.5t PM	6.6	5.4	9.90	136.0	2.1
S. Em (±)	0.50	0.26	0.15	1.00	2.14
C.D. 5% (P =0.05)	1.49	0.77	0.46	2.99	6.36

Conclusion

The obtained data showed that the significant effect of Vermicompost @ 2.5 t/ha + Poultry manure @ 2.5 t/ha is more effective for plant height, number of leaves, stem diameter, number of branches per plant, days taken to first flowering, days took to 50% flowering, fruit length, fruit weight, number of fruit per plant, fruit yield per plant (g) and fruit yield per hectare per (q).

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